

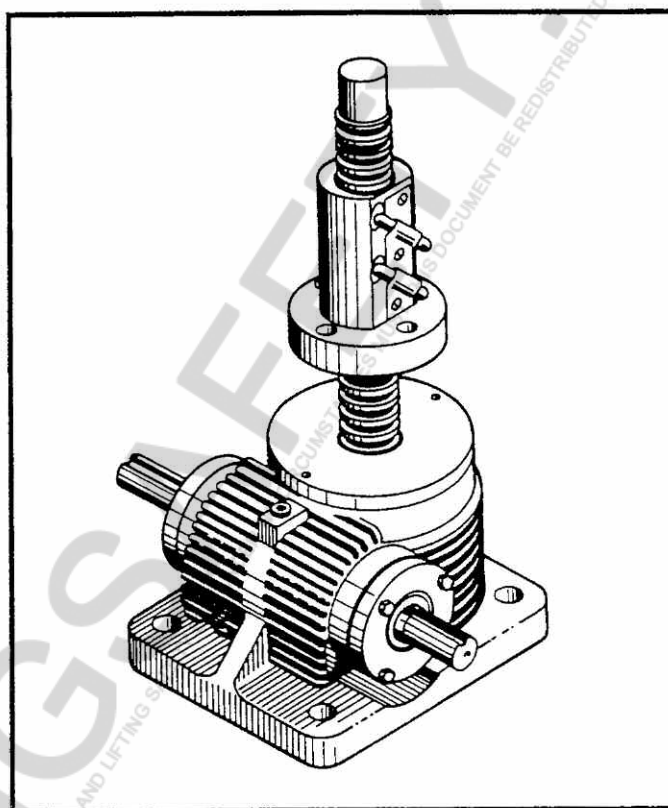
Duff-Norton®

MAINTENANCE INSTRUCTIONS

WITH PARTS LIST

PUBLICATION PART NO. SK-7515-20-1R

HIGH DUTY CYCLE ROTATING BALL SCREW ACTUATORS



**SERIES
7500**

IMPORTANT – CAUTION

This manual contains important information for the correct installation, operation and maintenance of the equipment described herein. All persons involved in such installation, operation and maintenance should be thoroughly familiar with the contents. To safeguard against the possibility of personal injury or property damage, follow the recommendations and instructions of this manual and keep it for further reference.

WARNING

The equipment shown in this manual is intended for industrial use only and should not be used to lift, support, or otherwise transport people.

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 **Duff-Norton**

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SECTION I GENERAL INFORMATION

1-1. General

This manual contains maintenance instructions for Duff-Norton 7500 Series high duty cycle actuators. It describes and details procedures for disassembly, cleaning, inspection, rebuilding and assembly of these actuators.

1-2. Industrial Use Only

The rotating ball screw actuators described and illustrated in this manual are intended for industrial use only and should not be used to lift, support or otherwise transport people unless you have a written statement from Duff-Norton Company which authorizes the specific actuator unit, as used in your application, as suitable for moving people.

1-3. Specifications

TABLE 1. Specifications — 7500 Series High Duty Cycle Rotating Screw Actuator

Model No.	7512	7516	7523
Max Load Cap. (Lbs.)	3,500	12,000	27,000
Rated Load Cap. (Lbs.)	2,000	5,200	13,000
Diameter of Lifting Screw (Inches)	1.171	1.5	2.250
	.413	.473	.50
Base Size (Inches)	Lead	Lead	Lead
	5½	7½	10¼
	X	X	X
	7.0	8¾	13¾
Worm Gear Ratio	6:1	8:1	10 ² / ₃ :1
Turns of Worm for 1" Raise	14.5	16.888	21.333
Horsepower per Jack (Maximum) @ 1750 R.P.M.	2	5	10
Starting Torque Max. Load (In. Lbs.)	75	200	420
Running Torque Max. Load (In. Lbs.)	60	170	350
Jack Efficiency Rating (Percentage)	70	70	65
Weight with Base Raise of 6" (Lbs.)	18	42	93
Weight for each Additional 1" Raise (Lbs.)	.42	.85	1.50
Hold Back Torque* at Rated Load (Lb. Ft.)	7	9	12

*Hold Back Torque is restraining torque at the worm shaft, to keep load from running down.

1-4. Dimensions

Typical Duff-Norton 7500 Series Actuator with Upright Rotating Screw

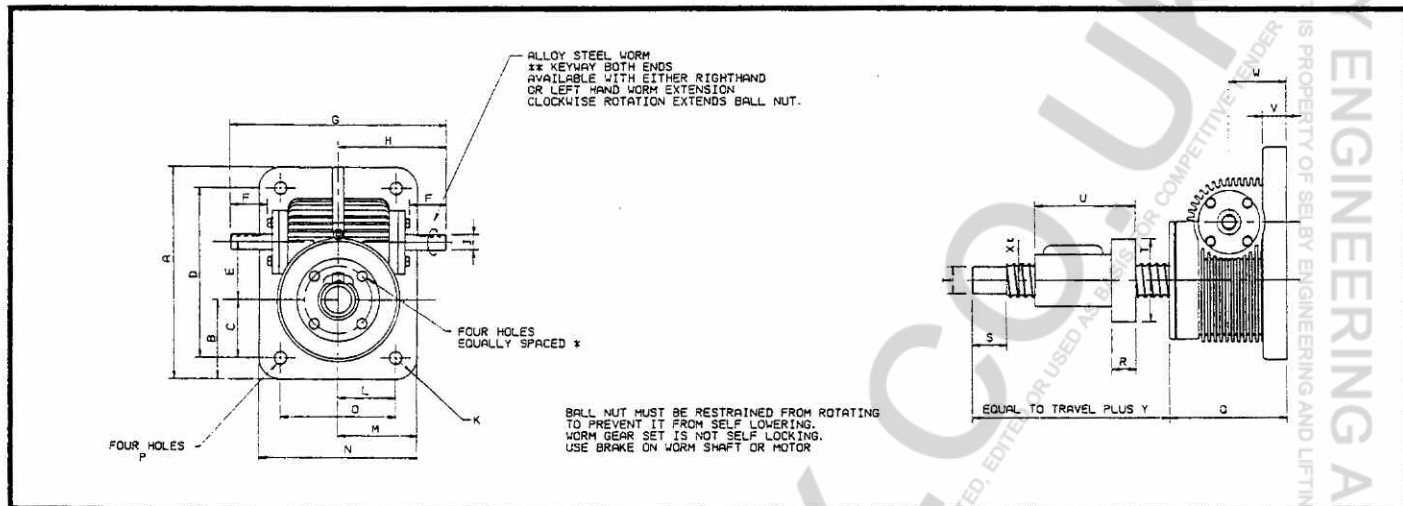


TABLE 2

Model No.	Dimensions (Inches)																				X†	Y			
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T			U	V	W
UM-7512	7	2 ³ / ₄	2.20	6	+0.001 -0.001 1.703	1.12	8.6	4.3	+0.000 -0.002 .750	+0.000 -0.002 .500	1/2R	2 ¹ / ₄	2 ³ / ₄	5 ¹ / ₂	4 ¹ / ₂	1 ³ / ₃₂	±.1 5 ¹ / ₄	.832	1.13	4.250	3.395	3/4	±.005 2.500	1.171 Dia. .4130 Lead	3.75
UM-7516	8 ³ / ₄	2 ⁷ / ₈	2.0	7	+0.003 -0.000 2.589	1 ¹ / ₁₆	11	5 ¹ / ₂	+0.000 -0.002 1.000	+0.000 -0.002 1.000	7/8R	2 ⁷ / ₈	3 ³ / ₄	7 ¹ / ₂	5 ³ / ₄	1 ¹ / ₁₆	±.1 5 ³ / ₄	.895	1	4.937	4.332	1	±.005 2.750	1 ¹ / ₂ Dia. .474 Lead	4.75
UM-7523	13 ³ / ₄	5 ¹ / ₈	3.75	11	+0.005 -0.000 3.750	2.38	14	7	+0.000 -0.002 1.750	+0.000 -0.002 1.000	1 ³ / ₈ R	3 ³ / ₄	5 ¹ / ₈	10 ¹ / ₄	7 ¹ / ₂	1 ³ / ₁₆	±.1 7 ³ / ₄	±.010 1.582	2 ¹ / ₄	5.375	±.040 6.706	1 ¹ / ₂	±.005 3.750	2 ¹ / ₄ Dia. .500 Lead	8.0

†Dimension includes diameter of ball screw with indicated lead for right hand single thread.

*Keyway for Model UM-7512 is 1/8 x 5/64 x 15/16 LG.

NOTE: When ordering, specify load and duty cycle.

*Model No UM-7516: 17/32 dia. on 4.06 dia. bolt circle.
Model No. UM-7523: 21/32 dia. on 4.375 dia. bolt circle.

Typical Duff-Norton 7500 Series Actuator with Inverted Rotating Screw

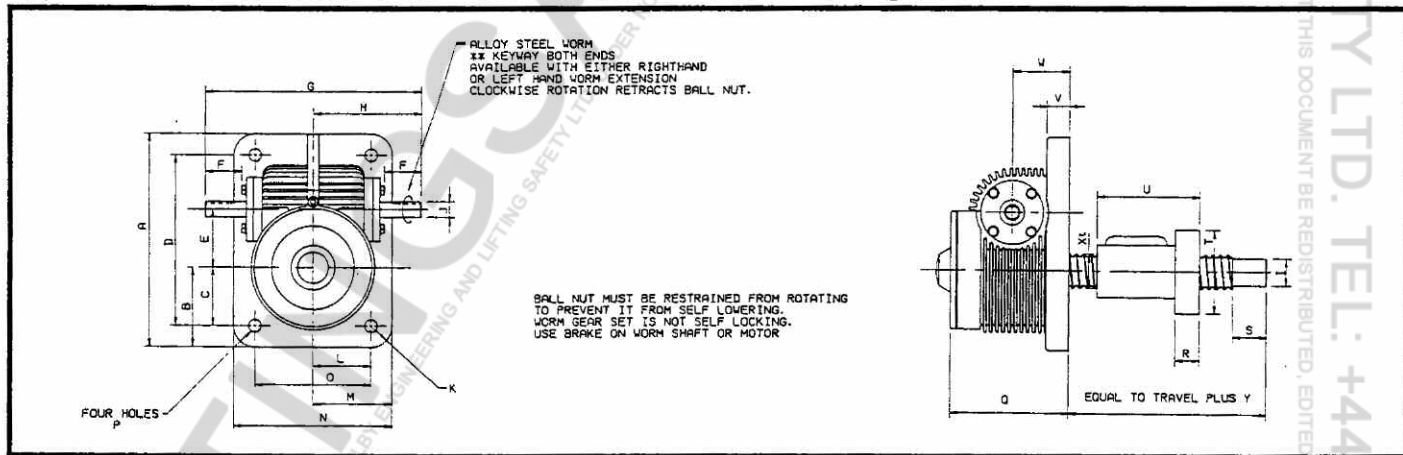


TABLE 3

Model No.	Dimensions (Inches)																				X†	Y			
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T			U	V	W
DM-7512	7	2 ³ / ₄	2.20	6	+0.001 -0.001 1.703	1.12	8.6	4.3	+0.000 -0.002 .750	+0.000 -0.002 .500	1/2R	2 ¹ / ₄	2 ³ / ₄	5 ¹ / ₂	4 ¹ / ₂	1 ³ / ₃₂	±.1 5 ¹ / ₄	.832	1.13	4.250	3.395	3/4	±.005 2.500	1.171 Dia. .4130 Lead	3.75
DM-7516	8 ³ / ₄	2 ⁷ / ₈	2.0	7	+0.003 -0.000 2.589	1.81	11	5 ¹ / ₂	+0.000 -0.002 1.000	+0.000 -0.002 1.000	7/8R	2 ⁷ / ₈	3 ³ / ₄	7 ¹ / ₂	5 ³ / ₄	1 ¹ / ₁₆	±.1 5 ³ / ₄	.895	1	4.937	4.332	1	±.005 2.750	1 ¹ / ₂ Dia. .474 Lead	4.75
DM-7523	13 ³ / ₄	5 ¹ / ₈	3.75	11	+0.005 -0.000 3.750	2.38	14	7	+0.000 -0.002 1.750	+0.000 -0.002 1.000	1 ³ / ₈ R	3 ³ / ₄	5 ¹ / ₈	10 ¹ / ₄	7 ¹ / ₂	1 ³ / ₁₆	±.1 7 ³ / ₄	±.010 1.582	2 ¹ / ₄	5.375	±.040 6.706	1 ¹ / ₂	±.005 3.750	2 ¹ / ₄ Dia. .500 Lead	8.0

†Dimension includes diameter of ball screw with indicated lead for right hand single thread.

NOTE: When ordering, specify load and duty cycle.

1-5. Important Precautions

In order to ensure that 7500 Series high duty cycle actuators provide good service over a period of years the following precautions should be taken:

1. Select an actuator that has a load rating greater than the maximum load that may be imposed on it.
2. The structure on which the actuators are mounted should have ample strength to carry the maximum load, and should be rigid enough to prevent undue deflection or distortion of the actuator supporting members.
3. It is essential that the actuators be carefully aligned during installation so that the lifting screws are perfectly plumb and the connecting shafts are exactly in line with the worm shafts. After the actuators, shafting, gear boxes, etc., are coupled together, it should be possible to turn the main drive shaft by hand. If there are no signs of binding or misalignment, the actuator system is then ready for normal operation.
4. The high duty cycle actuators should have a greater travel than is needed in the actual installation. Should it be necessary to operate these actuators at the extreme limits of travel, it should be done cautiously.

CAUTION

Do not allow actuator lifting nut travel to go beyond catalog closed height (Y) of actuator or serious damage to lifting nut or the internal jack mechanism may result. Refer to table of specifications (par. 1-4, Tables 2 & 3) for closed height (Y) of respective units.

5. The worm shaft speed for these actuators should not exceed 1750 RPM without consulting Duff-Norton.
6. The rotating screw should not be permitted to accumulate dust and grit on the threads. If possible, screws should be protected by some means such as a boot.
7. The ball screw and lifting nut should be checked periodically for excessive backlash and spalling of race ways.

CAUTION

Where the screw is not protected from airborne dirt, dust, etc., do not leave a heavy film of lubricant on the screw. Keep the ball screw barely damp with the lubricant. Inspect at regular intervals to be certain a lubricating film is present. Ball screws should never be run dry.

8. The lubrication procedures for normal and severe service conditions, as described in Section II, paragraph 2-1, should be closely followed.
9. Due to high efficiency of ball screw actuators, a brake must be used in conjunction with the motor selected for actuator positioning (refer to current catalog for brake selection data).

1-6. Warranty and Warranty Repair

Subject to the conditions stated herein, Duff-Norton will repair or replace, without charge, any parts proven to Duff-Norton's satisfaction to have been defective in material or workmanship. Claims must be made within one year after date of shipment. Duff-Norton will not repair or replace any parts that become inoperative because of improper maintenance, eccentric loading, overloading, chemical or abrasive action, excessive heat or other abuse.

Equipment and accessories not of Duff-Norton's manufacture are warranted only to the extent that they are warranted by the manufacturer, and only if the claimed defect arose during normal use, applications and service. Equipment which has been altered or modified by anyone without Duff-Norton's authorization is not warranted by Duff-Norton. EXCEPT AS STATED HEREIN, DUFF-NORTON MAKES NO OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

If you have any questions concerning warranty repair, please contact the Duff-Norton Company.

Authorization for return must be received from the Duff-Norton Company before returning any equipment for inspection or warranty repair.

SECTION II MAINTENANCE

2-1. Lubrication

Unless otherwise specified, actuators are shipped filled with oil which should be sufficient for the life of the unit under normal operating conditions. Under normal operation the oil temperature should not exceed a 100° rise above ambient or 200°F whichever is lower. If the actuator operating temperature exceeds 200°F for an extended period of time, it is strongly recommended the oil be changed using any of the recommended oils listed on the lubrication specification. (See paragraph 3-3 Page 14.)

For most applications, periodically lubricate the rotating ball screws with a cloth dampened with a good grade 10W30 oil. An instrument grade oil should be used in dirty and heavy dust environments while bearing grease is recommended for operating environments at extremely high temperatures. Extremes of temperature and other environmental conditions should be referred to Duff-Norton for recommended lubrication procedures.

CAUTION

Where the screw is not protected from airborne dirt, dust, etc., do not leave a heavy film of lubricant on the screw. Keep the ball screw barely damp with the lubricant. Inspect at regular intervals to be certain a lubricating film is present. Ball screws should never be run dry.

2-2. Rebuild Procedure

Duff-Norton recommends the following procedures for assembly and disassembly of 7500 Series actuators.

1. Tag critical parts to facilitate reassembly.
2. Mark mating surfaces to ensure proper meshing.
3. Clean and lubricate all parts as required.
4. All seals must be replaced when rebuilding.
5. All screws, washers and other small common parts must be replaced if damaged in any way.
6. Replace damaged or frozen lubrication fittings with new ones.

2-3. Required Tools

A bearing puller and press, soft jaw table clamp and common hand tools are necessary for proper assembly and disassembly.

2-4. Disassembly

Refer to Figures 2-1 and 3-1. When a numerical index number is referred to, the reference is to Figure 3-1. Reference should be made to Figure 2-1 when an alphabetical index number is used.

NOTE

Disassembly should be accomplished on a clean cloth. This is particularly important when disassembling the lifting nut assembly (24).

1. **Disassembly Inspection** (Refer to Figures 2-1 and 3-1). To determine the need for replacement of the ball screw (5) or the lifting nut (24) the following inspection should be made prior to disassembly of the lifting nut from the ball screw. Inspect the lifting nut assembly (B) and ball screw (A) as follows:
 - a. Lubricate the lifting nut assembly and ball screw. See paragraph 2-1.
 - b. Inspect the ball screw grooves (J) for signs of excessive wear, pitting, gouges, corrosion, spalling or brinelling. It is usually less expensive to replace the ball screw when any of the above conditions exist. If you feel, however, that it can be reworked, return it to Duff-Norton for final evaluation.
 - c. If none of the above conditions exist, check backlash. Secure the ball screw in a table clamp or similar fixture. Make sure that the screw shaft cannot rotate. Push firmly on the lifting nut assembly, first in one direction and then in the opposite direction. This axial movement of the lifting nut assembly is the backlash. While making sure that neither member rotates, measure the backlash with a dial indicator.

NOTE

Measure backlash at points of maximum usage. Backlash of .001" to .010" is acceptable.

- d. If the backlash is over .010" and the ball screw appears usable, disassemble according to Disassembly Step 2.
 - e. If the ball screw and lifting nut assembly do not show signs of excessive wear or damage, proceed to Step 3 and disassemble the lifting nut (24) from the ball screw (5).
2. **Disassembly of Lifting Nut** — Unless the maintenance personnel are trained in servicing ball screws, we do not recommend disassembling the lifting nut assembly (24). Follow Cleaning Step 1, paragraph 2-5, and Inspection Step 5, paragraph 2-6, to ascertain that the ball nut assembly is faulty before disassembling it. If inspection determines the ball nut assembly to be defective and trained personnel are not available, we recommend that both the ball nut assembly and ball screw (5) be replaced. When trained personnel are available, disassemble as follows:

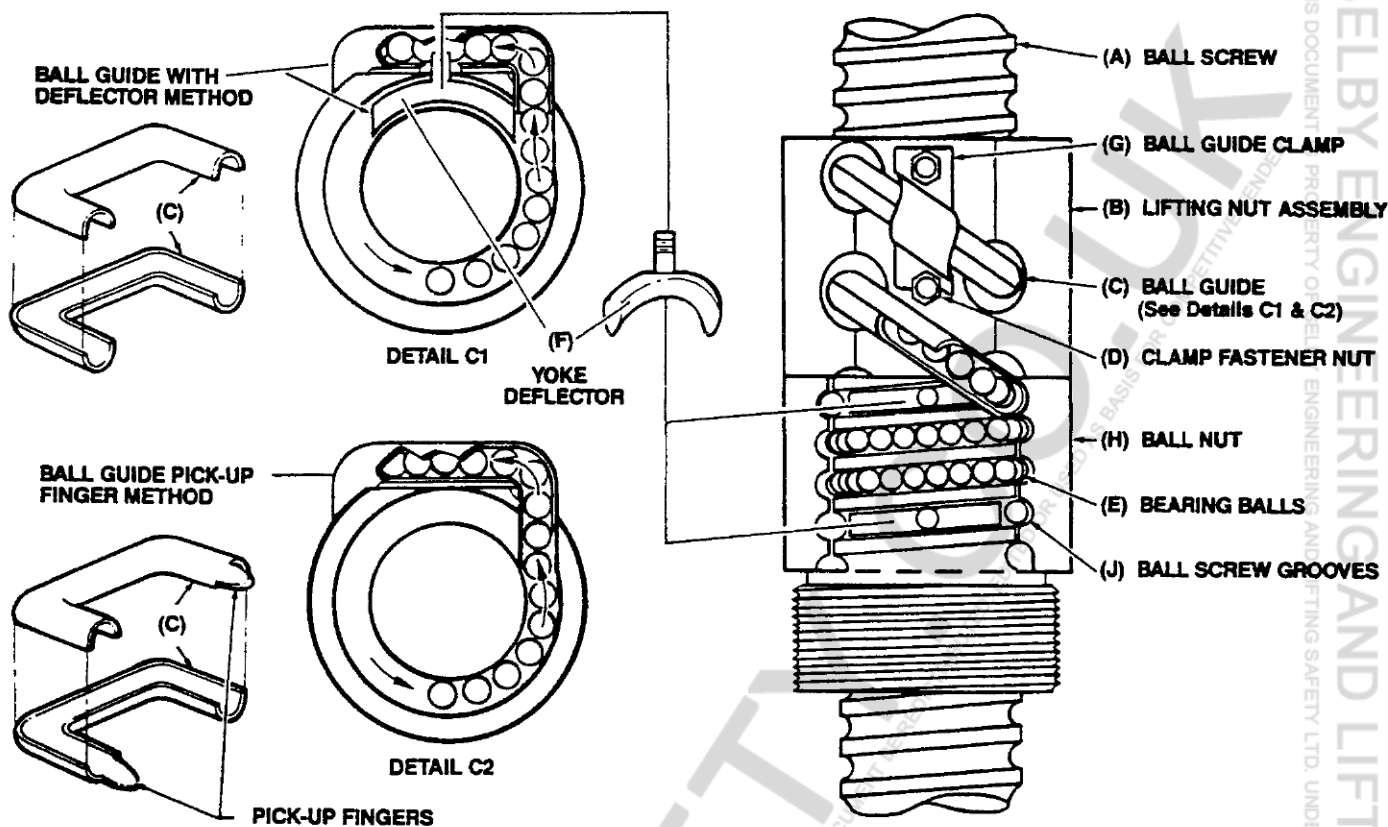


FIGURE 2-1. Lifting Nut and Screw Assembly

NOTE

Figure 2-1 shows two types of ball nut assembly recirculation systems. One type (Detail C1) has yoke deflectors (F) for directing the bearing balls (E) into the return circuit ball guides (C). The other type (Detail C2) has pick-up fingers which are a part of the ball guides.

- a. Remove ball guide clamp(s) by removing the attaching nuts (D).

CAUTION

When a ball guide clamp (G) holds more than one ball guide (C), secure each remaining ball guide with tape to prevent premature removal of the components of those circuits. Balls from each circuit must be kept separated in order to reassemble them in the proper circuit.

- b. Remove both halves of one ball return guide (C) simultaneously to prevent distortion.
- c. Remove bearing balls (E) from this circuit by rotating the ball screw (A) or the ball nut (H) slowly and allowing the balls to drop onto the cloth on which disassembly is taking place.
- d. Repeat steps A thru C for each remaining circuit.
- e. Remove the ball nut (H) from the ball screws (A).

On units with yoke deflectors (F), the ball nut must be rotated during removal since the yoke deflectors act as a thread in the ball screw grooves.

- f. When present, remove yoke deflector(s) (F) from the ball nut (H).

NOTE

Identify the two deflectors removed from the opposite ends of the ball nut so that they can be used for reference during the Inspection procedures.

- 3. **Disassembly of Lifting Nut (24) from Ball Screw (5)** (Refer to Figure 2-2).
 - a. Refer to Table 2-1 and select a tubular arbor with an I.D. slightly larger than the screw pilot diameter. The arbor O.D. should allow it to slide into the lifting nut between the screw and the bearing balls (E). The arbor should be long enough to extend 1 1/2" to 2" beyond each end of the lifting nut.

NOTE

Apply tape to arbor O.D. at end away from ball screw pilot to prevent lifting nut from accidentally running off of arbor during disassembly (an "O" ring with a large cross section, stretched over the arbor, is ideal for this purpose).

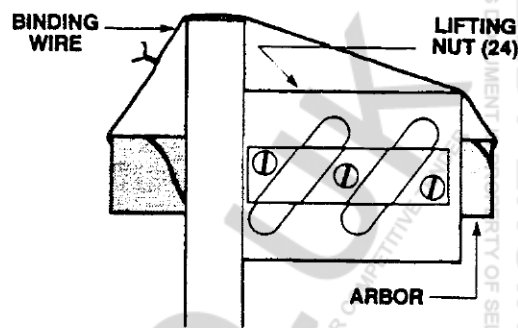
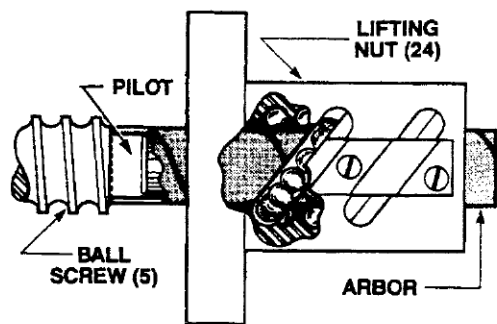


FIGURE 2-2. Ball Nut Storage Arbor

TABLE 2-1. Dimensions — Ball Nut and Storage Arbor

Actuator Model No.	Ball Screw Root Dia. (in)	Arbor O.D. (in)
7512	.820	.889
7516	1.140	1.156
7523	2.480	2.500

b. Holding arbor firmly against shoulder of ball screw pilot (5), unthread lifting nut (24) from ball screw (5). As lifting nut bearing balls (E) disengage from ball screw grooves (5), center lifting nut on arbor and remove arbor from ball screw pilot.

CAUTION

Lift arbor and lifting nut together, holding in place to prevent lifting nut from sliding off of arbor.

c. Pass binding wire through arbor and bind lifting nut and arbor together.

NOTE

Keeping assembly together in this manner will eliminate the need for complete assembly of the lifting nut during reassembly of the actuator. Complete actuator disassembly as follows:

4. Remove oil plugs (21) and drain oil from unit.
5. Remove plug (23) from shell cap (2) [inverted models].
6. Remove set screw (1) from shell cap (2) and remove shell cap from shell (3).

NOTE

It may be necessary to tap shell (2) with a hammer to loosen shell cap.

7. Remove top bearing (7) which may be attached to either shell cap (2) or worm gear assembly (6).
8. Remove cap screws (15) and flanges (16).

NOTE

Be careful not to lose shims (17).

9. Press oil seal (18) out of worm flange (16).
10. Remove worm bearing (20) cups from shell (3) by

tapping on end of worm (19) with a soft-head mallet or hammer. This will allow worm (19) to be positioned to the side.

11. With worm (19) positioned to the side away from gear (7) remove ball screw (5), gear (7) and gear extension (8) assembly from shell (3).
12. Remove worm (19) from shell (3).
13. Remove bearing (20) cones from worm (19) with puller or press.

NOTE

This step is not necessary if worm (19) or bearing (20) are not damaged.

14. Remove set screw (6) from locknut (14) [7523 models only].
15. Restraining ball screw (5) from turning (use soft jaws), remove locknut (14) [and thrustwasher (12), 7516 models] from ball screw (5).

NOTE

If all parts are to be reused, match-mark end of screw and locknut so they can be reassembled in the same order.

16. Remove worm gear (7) from ball screw (5).

NOTE

It may be necessary to tap on worm gear assembly to remove it. Use a soft-head mallet. Do not tap on gear teeth.

17. Remove key (13) from ball screw (5).
18. Remove gear extension (8) [and thrustwasher (11), 7516 models] from ball screw (5).
19. Remove bearing (4) cones from gear (7) and gear extension (8).

NOTE

This step is not necessary if gear (7), gear extension (8) or bearings (4) are not damaged and do not have to be replaced.

20. Remove "O" ring (10) from shell (3).
21. Remove oil seals (9) from shell (3) and shell cap (2).
22. **Inverted Models**—remove guide bushing (31) from shell (3).

23. If load bearing (4) cups are found to be worn, remove the cups by oven heating the parts [shell (3) or shell cap (2)] to approximately 400°F. A sharp rap [on shell (3) or shell cap (2)] may be needed to dislodge cones.
24. Disassembly is complete.

2-5. Cleaning

1. Use degreasing solvent to remove dirt, grease or oil from all parts. Be sure to flush the lifting nut assembly (24) thoroughly while turning the assembly over the arbor several times.

WARNING

Provide adequate ventilation during the use of cleaning agents; avoid prolonged breathing of fumes and contact with skin.

2. Use clean hot water or a soap solution for general cleaning of painted surfaces.
3. Dry parts thoroughly after cleaning.

NOTE

Before installing new parts, remove any rust preventive, protection grease, etc.

2-6. Inspection

1. Make a visual inspection of shell (3) for broken, cracked or distorted areas. Check threads of all bores for burrs or broken threads.
2. Check shell cap (2), worm gear assembly and flanges (16) for burrs or scratches on their working or mating surfaces.
3. Check small common components (screws, etc.) and replace as required.
4. Check bearings (4 and 20) for seizure, galling or play and replace as required.
5. Inspect the lifting nut components (B) as follows:
 - a. Inspect ball return guides (C) for distortion or excessive wear.
 - b. 1) If there is more than one circuit in the ball nut assembly (B), count the bearing balls from each circuit. Each circuit should have the same number (within a variation of three balls).
2) Check random samples (about 1/4 of the balls for a circuit) for the following:
 - True roundness (.0001 inch maximum variation allowed).
 - Signs of scuffing or fish scaling.
 - More than .0001 inch diameter variation between balls of the same circuit.

Where the random sampling shows balls out of round, signs of scuffing or variation of diameter in excess of

.0001, or short count in any circuit, replace all balls in the unit with a complete set of new bearing balls.

CAUTION

In order to ensure proper operation and long life of the serviced assembly, IT IS IMPERATIVE that the diameters of all the replacement balls do not vary in excess of .00005 inch. Make certain that balls used meet the above specification. (NOTE: Use only chrome alloy steel balls—carbonized balls or carbon steel balls will not provide adequate life.)

Basic Actuator No.	Nominal Ball Diameter	Number of Circuits	Approximate No. of Balls
M-7512	9/32	2	60
M-7516	11/32	2	86
M-7523	3/8	2	154

- c. Where units include deflector yokes, check the ends of the yokes for wear or brinelling. Wear can be determined by comparison with the unused ends of the two outside yokes. (These were marked in Disassembly Step 12F.) Since these ends have not been subjected to wear from balls they are in a like-new condition. Where excessive wear or brinelling is evident, replace the yokes.
- d. Where units have pick-up fingers (short extensions at the end of the ball return guides), inspect for brinell impressions at the tips. Remove any burrs on the fingers.
- e. Inspect the internal grooves of the ball nut (J) for signs of excessive wear, pitting, gouges, corrosion, spalling or brinelling in the ball groove area. On the large ball nuts, running the tip of your finger along the groove will enable you to detect a secondary ridge in the ball nut groove (J) when wear is excessive or brinelling has occurred. (The extended lead of a mechanical pencil can also be used as a groove probe.) If inspection indicates any of these flaws, all components of the ball nut assembly should be replaced. The exact ball nut assembly (7) is available on an arbor. When ball nut is usable proceed with reassembly.

2-7. Assembly

1. Press load bearing (4) cones onto worm gear (7) with small end of cones away from gear face and gear extension (8), small end of cone away from flange.
2. Be sure cones are seated properly against gear shoulder.

NOTE

Pack bearing cones with a NLG1 No. 1 or No. 2 grease before assembly.

3. a. **Upright Unit.**

- 1) Assemble [thrustwasher (11), 7516 models only and] gear extension (8) on screw (5), bearing journal facing toward ball screw thread.
- 2) Insert key (13) in screw (5).
- 3) Assemble gear (7) on screw (5), bearing journal facing away from ball screw thread.

b. **Inverted model**

- 1) Assemble thrustwasher (11)[7516 models only] on screw (5).
- 2) Insert key (13) in screw (5).
- 3) Assemble gear (7) on screw (5), bearing journal facing toward ball screw thread.
- 4) Assemble gear extension (8) on screw (5), bearing journal facing away from worm gear (7).

- 4. Assemble [thrustwasher (12), 7516 models only and] thread locknut (14) on screw (5). Tighten securely against gear/gear extension. Make certain that this assembly is tightly drawn up.

CAUTION

7523 units locknut (14) tapped set screw hole is not centered. Assemble with tapped set screw hole farthest away from the worm gear face.

- 5. Install set screw (21) in locknut (20) locking the nut in place [7523 units only].

NOTE

If new parts have been installed, spot drill thru tapped hole for set screw.

- 6. Press gear oil seals (9) into the shell (3) and shell cap (2) with sealing elements pointing inward.
- 7. Press load bearing cups (4) into shell (3) and shell cap (2) after applying an anti-sieze compound to the bearing bores.

NOTE

Small cup diameter should point toward oil seal.

- 8. Install "O" ring (10) in shell (3) [groove below thread].
- 9. **Inverted units only.** Install guide bushing (31) in shell (3). Guide bushing must be flush with base. Lock guide bushing in place by peening on the thread O.D. of the bushing shell with a center punch.

- 10. Press worm bearings (20) cones onto worm shaft (19) making sure bearings are seated properly. The small end of the cone should point to the worm end of worm shaft and away from threads.

NOTE

Pack bearing cones with a NLG1 No. 1 or No. 2 grease before assembly.

- 11. Assemble worm (19) into shell (3) while positioning worm (19) to side. Assemble screw (5), worm gear (7) and gear extension (8) assembly into shell (3) until worm (19) and gear (7) mesh while bottom load bearing (4) seats into its cup.

NOTE

The shell oil seal (9) should be examined in case sealing lip was rolled back by gear.

- 12. Tap worm bearing (20) cups into place in the shell (3).
- 13. Press oil seals (18) into worm flanges (16).

NOTE

Sealing element should point inward.

- 14. Position worm flanges (16) with at least one shim (17) on each flange. Apply non-hardening industrial sealant such as Permatex No. 2 to the flange bolts. Bolt flange into place. This should be done carefully.

NOTE

To prevent keyseat from cutting seal, apply a strip of tape over keyseat.

NOTE

After worm, worm gear (7), gear extension (8) and ball screw (5) are in place and flanges (16) are assembled, strike each end of worm (19) shaft sharply with a wooden mallet to seat bearing properly. Re-check flange bolts for tightness. Worm should turn freely with minimum drag and end play. If too much end play is present, remove shims as required. If worm does not turn freely, add shims as required.

- 15. Apply non-hardening industrial sealant such as Permatex No. 2 to the shell cap (2) threads.
- 16. Install shell cap (2) and tighten.

NOTE

In order to eliminate free play in the load bearings (4), preload the actuator load bearings (4) by tightening the shell cap (2) until worm torque is equal to torques in table.

Basic Model No.	Worm Torque In.-Lbs.
7512	9-12
7516	32-38
7523	67-83

NOTE

Shell cap flange does not necessarily have to bear against top of shell; there will usually be a gap. This will put a slight drag on worm. If worm is hard to turn, back off slightly on shell cap.

- 17. Install set screws (1) in shell cap (2). Tap shell cap sharply with hammer and re-tighten set screw.

NOTE

If new parts have been installed, it may be necessary to respot holes for set screws.

18. Screw the lower oil plug (21) into place and add oil to the actuator until the level reaches the centerline of the worm or the gear and worm mesh whichever is higher. See approved lubricant listing. (SK-7515-16) (See pragraph 3-3 page 14.)
19. Install remaining oil plugs (21).
20. Assembly of lifting nut (24) to ball screw (5) - If lifting nut has been disassembled, reassemble on ball screw per step 20-1. If lifting nut was not disassembled and was removed on an arbor tub, reassemble on ball screw per Step 20-2.

20-1. Refer to Figure 2-1 and assemble the lifting nut (24) as follows:

- a. Where the lifting nut assembly is equipped with deflector yokes (F), install these and secure temporarily by running the locknuts down the studs and tightening slightly.
- b. Position the lifting nut (H) on the ball shaft. (All ball nuts with deflector yokes must be screwed on. Other ball nuts should slide up the ball shaft without trouble.)

NOTE

Flange of lifting nut should face toward actuator shell and away from ball screw pilot.

- c. Using dowels with an outside diameter approximately equal to the diameter of the bearing balls, center lifting nut grooves with the ball shaft grooves by inserting dowels into each of the ball nut return circuit holes. Remove the second dowel from one end. With the ball return holes up, fill the circuit with bearing balls from the container corresponding to that circuit. Turning the screw in the ball nut will help to feed the balls into the groove. When the circuit is full, the balls will begin to lift the end dowel from its position. To be sure there are no voids, lightly tap the top bearing ball and see if the end dowel moves. The remaining balls in the container should fit into one of the halves of the return guide with space for about two to four balls left.

NOTE

There must be some free space in the ball circuit so the balls will roll and not skid. Do not try to add extra balls into a circuit.

- d. Place a dab of bearing grease at each end of the half return guide (C) to hold the balls in place. Now take the other half of the return guide and place it over

the ball nut circuit that has been filled with bearing balls and insert the two ends of the ball guide into the respective holes in the ball nut. Seat by tapping gently with a rawhide or plastic mallet.

NOTE

Where more than one ball circuit must be filled in the ball nut, tape the ball return circuit guide to the ball nut to prevent accidental removal.

- e. Repeat the filling procedure for the remaining ball circuits. With all ball circuits filled and all return guides in place, secure the return guides with retaining clamp(s) (G) and nuts (D).

CAUTION

Care should be taken to ensure that balls are not accidentally trapped between circuits in units having pick-up fingers. (In deflector type design, the deflectors fill this void space.) Be sure screw and ball nut are properly lubricated (see paragraph 2-1).

- f. Wrap tape around the ball grooves at the end of the screw shaft to prevent the ball nut from accidentally rolling off. Inspect the assembly for free movement of the ball nut assembly along the entire stroke. There should be no binding, squeal, or roughness at any point.
- g. Check backlash per Inspection Step 5C. If backlash exceeds .010 inch, one of the two corrective steps may be followed.
 - 1) The ball nut assembly and/or ball screw may be replaced.
 - 2) Backlash can be reduced by replacing all the bearing balls with a larger size. If the diameters of the bearing balls are increased by .001 inch, backlash is decreased by .003 inch.

CAUTION

In order to ensure proper operation and long life of the serviced assembly, it is **IMPERATIVE** that the diameters of all the replacement balls do not vary in excess of .00005 inch. Make certain that balls used meet this specification. Use only chrome alloy steel balls — carbonized balls or carbon steel balls will not provide adequate life.

20-2. Refer to Figure 2-2 for reassembly of lifting nut (24) from tube arbor to ball screw (5).

- a. With lifting nut centered on arbor tube, grasp lifting nut and arbor to prevent lifting nut from running off of arbor, and remove binding wire.
- b. Position arbor over ball screw (5) pilot.

NOTE

Flange of lifting nut should face toward actuator shell and away from ball screw pilot.

- c. Gently slide lifting nut (24) down arbor and thread it onto ball screw (5). After lifting nut is completely threaded onto ball screw, remove arbor from ball screw pilot.

CAUTION

Wrap tape around ball screw threads (below pilot and above lifting nut) to prevent lifting nut from running off of ball screw during installation of unit.

21. On 7523 inverted model, install plug (23) in shell cap (2).

Assembly is now complete.

**SECTION III
ILLUSTRATED PARTS LIST**

3-1. General

This section contains an exploded illustration of the 7500 Series high duty cycle rotating ball screw actuators. The

number adjacent to each part on the illustration is the index number. Keyed to this index number on the parts list is the part name.

3-2. Parts List for 7500 Series Rotation Ball Screw Actuators

Index No.	Part Name	Qty. Req.
1	Screw, Set (Shell Cap)	2
2	Shell Cap	1
3	Shell, Actuator	1
4	Bearing, Top & Bottom	2
5	Ball Screw	1
6	Screws, Set (Locknut) (7522 Model)	1
7	Worm Gear	1
8	Gear Extension	1
9	Oil Seal (Gear)	2
10	"O" Ring	1
*11	Thrustwasher	1
*12	Thrustwasher	1
13	Key	1
14	Nut, Lock	1
15	Screw, Cap	8
16	Flange, Worm	2
17	Shim, Flange	2
18	Seal, Oil (Worm)	2
19	Worm	1
20	Bearing, Worm	2

Index No.	Part Name	Qty. Req.
21	Oil Plug	3
22	Name Plate	1
23	Plug (7523 Model Inverted)	
24	Ball Nut & Flange Adaptor Assy. (consists of Index Nos. 24A thru 30)	1
**24A	Ball Nut (Body)	1
**25	Deflector, Yoke	As Req'd.
**26A	Guide, Ball (used when yoke deflectors are used)	As Req'd.
**26B	Guide, Ball (used when yoke deflectors are not used)	As Req'd.
**27	Clamp, Ball Guide	As Req'd.
**28	Nut, Clamp Fastener	As Req'd.
***29	Bearing Balls (replace only in sets) (specify if oversized balls are required)	See Below
**30	Flange Adaptor	
31	Guide Bushing (inverted models only)	
	Screw Drive (Name Plate)	2

*7523 Models only

**Not sold as spares. Order Index No. 24 Ball Nut And Flange Adaptor Assembly.

*****CAUTION:** In order to ensure proper operation and long life of the serviced assembly, it is imperative that the diameters of all replacement balls do not vary in excess of .00005". The following information is supplied for informational purposes only.

Basic Actuator No.	Nom. Ball Diameter	No. of Circuits	Approx. No. of Balls	No. of Balls per Circuit
M-7511	9/32	2	60	30
M-7515	11/32	2	86	43
M-7522	3/8	2	154	77

When ordering spare parts, be sure to include:

1. The nameplate model number of your actuator.
2. Index number and name of part.

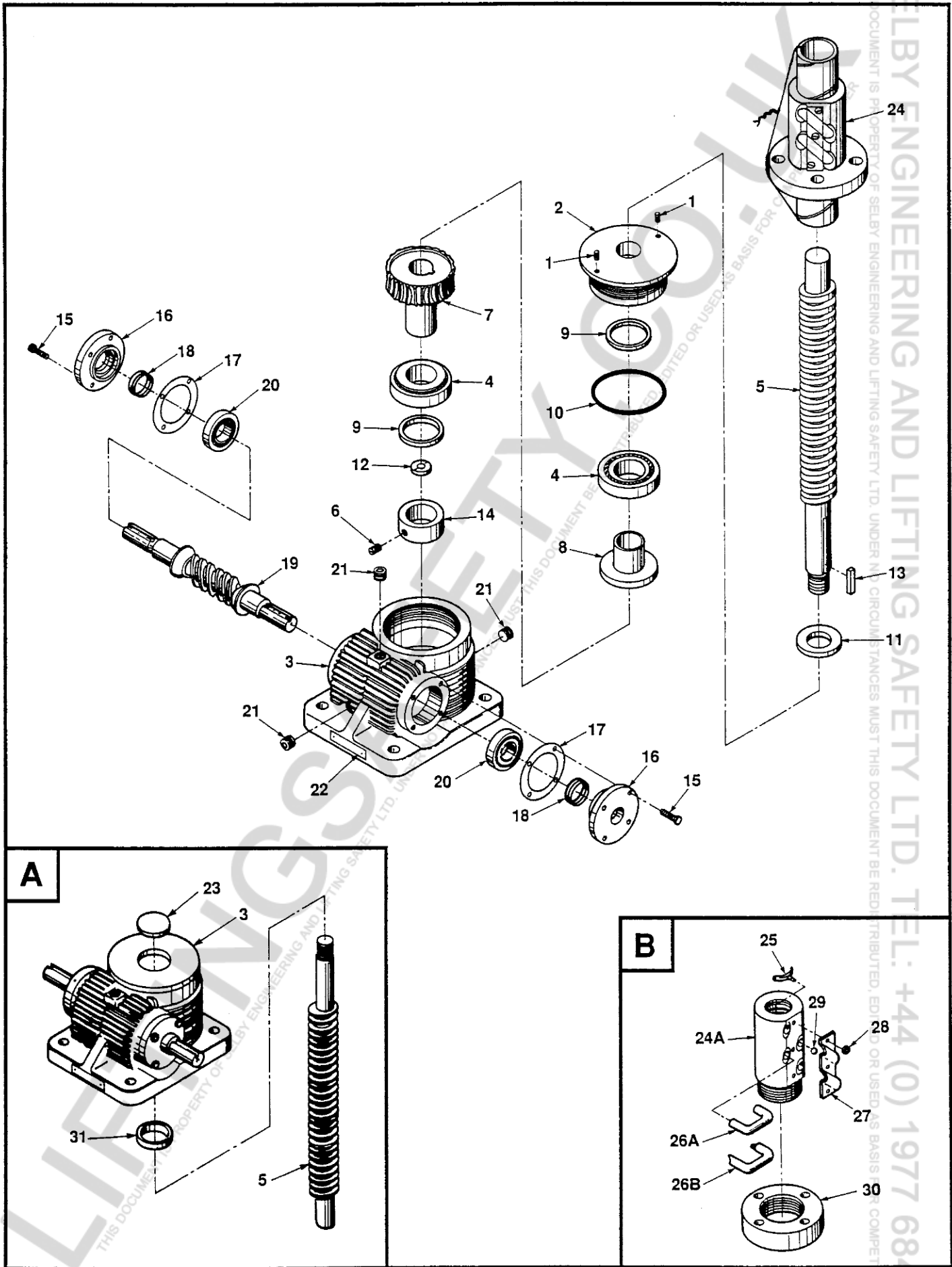


FIGURE 3-1. 7500 Series High Duty Cycle Rotating Ball Screw Actuator

3-3. Suggested Lubricants for High Duty Cycle Actuator††

Ambient Temp. Degrees Fahrenheit	
†15-50°F	50-125°F
8 EP	8A EP
8 EP	8A EP

Extracted from AGMA Standard 250.04 "Lubrication of Industrial Enclosed Gear Drives."

VISCOSITY RANGE FOR VARIOUS AGMA LUBRICANTS	
AGMA Lubricant No.	Viscosity Range cSt @ 40°F
7 EP	125 to 150 SSU
8 EP	150 to 190 SSU

NOTE: All oils listed meet AGMA minimum viscosity index specification of 90.

Actuator No.	Approximate Oil Capacity
7512	16 oz.
7516	16 oz.
7523	24 oz.

†Pour Point of the oil used should be less than the minimum ambient temperature expected.

AGMA 7 EP			AGMA 8 EP			MANUFACTURER
BRAND NAME	Pour Point °F	Viscosity @ 40°C cSt	BRAND NAME	Pour Point °F	Viscosity @ 40°C cSt	
OMALA 460	10	431	OMALA 680	10	633	SHELL OIL CO.
ENERGEAR EP 460	5	432	ENERGEAR EP 680	5	626	BP OIL CO.
CHEVRON NL 460	0	437	CHEVRON NL 680	5	646	CHEVRON OIL CO.
MOBILGEAR SHC 460	-20	440	MOBILGEAR SHC 680	-9	645	MOBIL OIL CO.

†† The listing is incomplete. The customer may use other oils if he verifies equivalency to those listed.

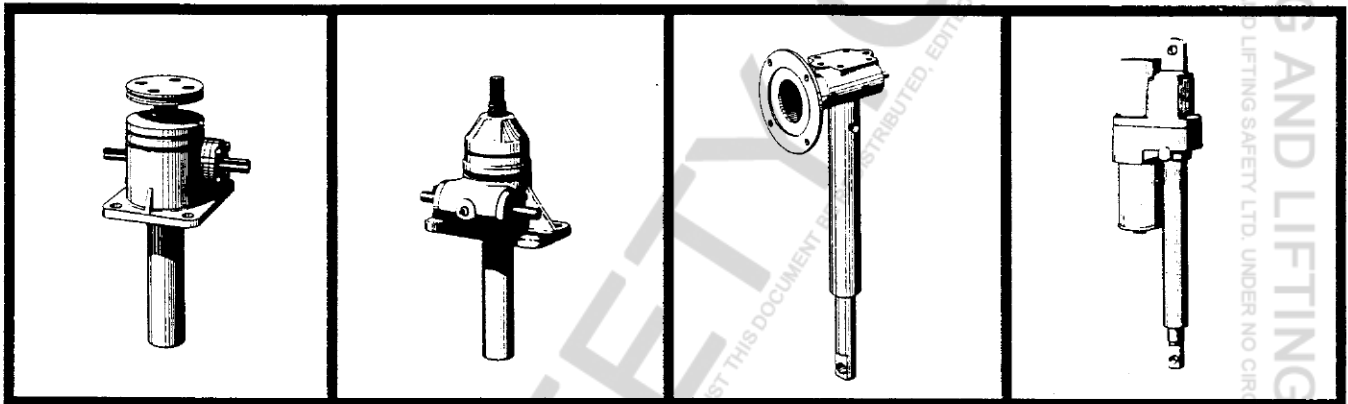
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Machine Screw Actuators.
Capacities from 1/4 to 250 tons. Worm gear ratios from 5:1 to 50:1. More than 200 standard combinations to choose. Can be operated manually or by gear motor. Used to push, pull, apply pressure, or as linear actuators. Hold loads indefinitely without creep, when not subject to vibration.

Ball Screw Actuator.
Capacities from 1/2 to 50 tons. Ball bearing screw and nut design reduces friction, increases efficiency as much as 70%. Permits linear motion up to 300 in/min @ 1800 rpm worm shaft speed. Available in 40 standard models. Multiple units may be synchronized for uniform raises to 10 feet.

Modular Actuators.
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Capacities to 3/4 ton. Choice of 115 VAC or 12 VDC motors for indoor or outdoor applications. Standard raises from 3" to 24". Speeds to 145 in/min. All components sealed in a corrosion-resistant, aluminum alloy die-cast housing. Fully adjustable limit switches available on some models.

For more information on these or other Duff-Norton® actuators, ask your local distributor or Duff-Norton District Sales Manager for Catalog 172. Or write factory.

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